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POSSIBLE RETURNS FROM PLANTED LOBLOLLY PINE

by

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The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the Station. In some cases these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

POSSIBLE RETURNS FROM PLANTED LOBLOLLY PINE

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In setting up a calculation of costs and returns from planted stands of any species of southern pine, it must be borne in mind that information is not yet available on the behavior of such stands over a long period of time or throughout a rotation. Any calculations must therefore be more or less theoretical, and there is always the possibility that fire or insect damage may upset plans and expectations.1/ In this connection it might be well to caution against the planting of large areas to any one species and age-class of southern pine, especially loblolly. Since most planted loblolly stands in the South have been subject to severe attacks from tip moth, which have caused stunting and retardation of height growth during the first few years, consideration should be given to the possibility of planting slash pine in mixture with the loblolly in order to minimize this danger. The growth rate of the slash pine is as good as (or better than) that of loblolly, and observations indicate that slash will survive almost as low temperatures as loblolly, although the natural range of slash is restricted to a more southern belt.

As a basis for calculations in this paper, it is assumed that loblolly will be planted in pure stands, although the planting of slash pine with the loblolly probably would not materially affect the calculations here presented. It is also assumed that the trees will be planted 6 feet apart in rows 8 feet apart. With the stand established, the determination of returns and costs is made by applying current stumpage values and other economic data on the basis of the best available growth and yield data.

It is planned to do no thinning in the stand until the branches have died up to a desirable height and until most of the trees are merchantable for pulpwood. This will be when the stand is approximately 20 years of age. At that time, on an average site, the distribution of trees and volumes by diameter-classes should be approximately as shown under stand "before thinning" in table 1. This total volume of 1400 cubic feet is equivalent to 17.5 standard (4 ft. x 4 ft. x 8 ft.) cords (based on a converting factor of 80 cubic feet of wood per standard cord of rough wood).

When the stand is 20 years of age, it is planned to thin it in order to continue or increase the growth rate of the reserved trees; to improve the stand composition by removing the rough, crooked, and defective trees; and to salvage some of the trees that would otherwise be lost through mortality. It is assumed that this thinning will be made chiefly in the larger diameter-classes, since a certain proportion of the larger trees will

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1/ Owing to the fact that it is impossible to forecast accurately the increase in effectiveness of fire protection; the danger from loss caused by insects, sleet damage, windstorms, etc.; or the increase or decrease in the amount of taxes assessed against timberland in the next 40 years, this paper attempts only to serve as a basis for discussion and to give an indication of the possibilities of growing loblolly pine in planted stands in the South.

undoubtedly be very limby and subject to the formation of black knots if left to grow. It is also planned to remove 6.6 cords per acre in this first thinning, after which the reserved stand will be as shown in table 1.

Table 1. Stand per acre 20 years old

Diameter at breast height	Before thinning		After thinning	
	Number of trees 1/	Volume 2/	Number of trees	Volume 2/
Inches		Cubic feet		Cubic feet
4	122	98	115	92
6	239	681	168	479
8	81	505	40	250
10	11	116	5	53
Totals	453	1400	328	874

1/ From table 162 of U.S.D.A. Miscellaneous Publication No. 50, but excluding those trees 4 inches in diameter or less which are severely suppressed. At present no final basis exists for determining the exact average yield from plantations. The above table, as well as the ones that follow, however, check with the best available information on planted and well-stocked natural stands.

2/ Volume in cubic feet of solid wood (inside bark) to a merchantable top-diameter, which varies with the size of the trees, the minimum being about 3 inches inside bark.

This thinning will open up the stand considerably and will leave only the best trees for additional growth, which it is reasonable to expect will correspond to that measured for similar stands. Based upon the best available data, therefore, during the next 8 years 35 percent of the trees in a given diameter-class will not move out of the present diameter-class; 50 percent of the trees in a given diameter-class will increase 1 diameter-class (2 inches); and 15 percent of the trees in a given diameter-class will increase 2 diameter-classes (4 inches).

In order to maintain this growth rate, it is planned to make a second thinning as soon as the stand has closed in, which should be at the end of about 8 years. Assuming the above rates of growth, the stand before thinning at the age of 28 years would be as shown in table 2. The total volume of the stand per acre is 1,928 cubic feet of wood, or 24.1 cords. This thinning, which will again remove trees from all merchantable diameter-classes in order to improve the quality of the residual trees, should remove approximately 10.5 cords per acre, leaving a residual stand as shown in table 2.

By assuming the same mortality and growth rates as during the first 8-year period, it is possible to predict the stand at the end of a second 8-year period or when the stand is 36 years old, at which time the distribution of trees and volumes by size-classes should be about as shown in table 3.

Table 2. Stand per acre 28 years old

Diameter at breast height	Before thinning		After thinning	
	Number of trees 1/	Volume	Number of trees	Volume
Inches		Cubic feet		Cubic feet
4	30.2	29	30.2	29
6	96.0	334	45.0	157
8	102.5	782	50.0	382
10	44.4	585	33.4	440
12	8.5	175	4.0	82
14	.8	23	-	-
Totals	282.4	1928	162.6	1090

1/ Mortality in an 8-year period is assumed to be 25 percent of the trees in the 4-inch class; 10 percent of those in the 6-inch class; and none in the 8- and 10-inch classes. Owing to the fact that most of this is a result of injury at the time of thinning, the stand table showing the number of trees after thinning is reduced by the above amounts before the resulting stand 8 years hence is calculated.

Table 3. Stand per acre 36 years old

Diameter at breast height	Before thinning		After thinning	
	Number of trees	Volume	Number of trees	Volume
Inches		Cubic feet		Cubic feet
4	7.9	9	7.9	9
6	25.5	96	20.0	75
8	41.2	352	26.0	222
10	42.8	653	32.0	488
12	25.6	611	25.0	597
14	7.0	236	6.0	203
16	.6	27	.6	27
Totals	150.6	1984	117.5	1621

The stand at 36 years of age would have approximately 24.8 cords to the acre. This would be available for pulpwood if everything were cut for pulpwood at this time, but the stand now has been nursed through the period when it is most susceptible to fire and to attacks from disease and insects, and it has reached the age at which reproduction can be obtained at little or no cost. With 33 trees (in the 12-inch and larger diameter-classes) large enough to be marketable for sawtimber and growing both in volume and quality at a very rapid rate, it would appear, therefore, to be extremely poor forestry and poor business, even for a pulpmill, to cut the stand clean for pulpwood at this period. The standard sawtimber stumpage price for loblolly pine sold from National Forests in 1937 was $7 per M board feet while the price for pulpwood stumpage was only $1 per cord. It is thus conservative to assume that 36 years from now the private owner will sell his pine

sawtimber stumpage for $6 per M board feet and his pulpwood stumpage for $1 per cord, but assuming these stumpage values, those trees that will make either pulpwood or sawtimber would have a stumpage value of about $2 per M board feet when cut into pulpwood and about $6 per M board feet when cut as sawtimber. It would, therefore, be distinctly to the advantage of the forest owner to consider integrated utilization of his forest products, and to manage his property so that the maximum volumes of sawtimber can be cut at regular intervals.

Studies made in second-growth shortleaf-loblolly pine indicate that approximately one-third of the cubic volume of a sawtimber tree has a greater value for pulpwood than for sawtimber. Also it is desirable to make pulpwood thinnings and improvement cuttings in a sawtimber stand at approximately 8-year intervals, in order to maintain the growth rate and improve the quality of the sawtimber. Therefore, it will be possible to manage this planted stand so as to obtain a good continuous yield of pulpwood as well as a good continuous yield of high-value logs. Having decided upon this type of management, the cut at the 36th year will be limited to those trees that need to be removed to improve the stand and to maintain the growth rate. No logs will be cut at that time because of the smallness and poor quality of the trees (which are growing rapidly, however, both in volume and quality), but approximately 4.5 cords of pulpwood will be removed. The stand after the thinning is shown in table 3.

At the time of the next cut, 8 years later (when the stand is 44 years old), it should be possible to obtain about 2.8 cords of pulpwood and 1,300 feet of high-grade logs per acre. Beginning at 52 years, however, it should be possible to obtain 3.6 cords of pulpwood and 3,000 board feet of high-quality sawlogs every 8 years under sustained-yield forest management.

Financial Calculations

With land valued at $4 per acre, planting costs at $4 per acre, and the interest rate at 3 percent,3/ it seems desirable to determine the cost of planting and carrying the stand through the 36th year, based on both present and estimated future current expenses. In a large part of the South at the present time, taxes per acre on planted or natural second-growth stands amount to 12¢ or less a year. Fire protection costs timberland owners 2¢ (with the Federal Government matching this amount), and administration costs are approximately 5¢ a year. This makes a total annual current expense of 19¢ an acre. Although it is very unlikely that current expenses will double in the next 36 years, the costs of growing the stand through the 36th year both under present costs and under costs double those at present are shown in table 4.

3/ Interest rates for borrowed money usually run from 5 to 7 percent, but these include risks and costs to the lender. Earnings of most forms of investment seldom net over 3 percent compounded.

Table 4. Costs of planting and growing loblolly pine for 36 years under present costs and under costs twice the present ones

Item	With present costs for taxes, fire protection, and administration	With twice present costs for taxes, fire protection, and administration
Interest on investment in land ($4) compounded at 3% for 36 years	$7.59	$7.59
Cost of planting investment ($4) plus interest compounded at 3% for 36 years	11.59	11.59
Cost of taxes, fire protection, and administration paid annually for 36 years, plus interest compounded at 3% (Present costs per acre are taxes 12¢, administration 5¢, and fire protection 2¢.)	12.02	24.04
Total cost of stand during 36 years	$31.20	$43.22

With pulpwood stumpage worth $1 per standard cord, the value of the various thinnings compounded at 3 percent through the 36th year would be as follows:

6.6 cords cut at the 20th year at $1 per standard cord plus interest compounded at 3% for 16 years	=	$10.59
10.5 cords cut at the 28th year at $1 per standard cord plus interest compounded at 3% for 8 years	=	13.30
4.5 cords cut at the 36th year at $1 per standard cord	=	4.50
Total		$28.39

The value of the pulpwood cut from the stand as thinnings up to the end of the 36th year is $28.39, including interest at 3 percent. This is in addition to the growing stock remaining, which is equivalent to approximately 20.3 cords, worth $20.30, if valued only for pulpwood. Thus, if figured on a 36-year pulpwood rotation at 3 percent compound interest, the total gross return per acre is $48.69, while the total cost is $31.20, based on present expenses, or $43.22 if based on estimated future expenses; this leaves a net income of $17.49 per acre, based on present expenses, or $5.47 based on increased expenses. The average annual net income per acre per year is therefore 49¢ if present costs continue, or 15¢ if current costs increase 100 percent. There is a very real possibility, however, that pulpwood will double in stumpage value within the next 20 years, and if such were the case the average annual net income would amount to $1.84 per acre if based on present current expenses, or $1.50 if based on the estimated future current costs. Thus, with a substantial increase in pulpwood stumpage values, the planting of loblolly or other pines would be very profitable.

In comparison with a system of management which would grow and cut all trees 4 inches and over d.b.h. for pulpwood on a 36-year rotation, a system of selective timber management with integrated utilization appears to be more profitable. Under the latter system, regeneration is obtained naturally in openings, following cutting of sawtimber trees, without the cost of planting. Also, the serious fire and insect hazard that is always present in young, even-aged stands covering extensive areas is much less serious in those scattered patches of young pine that under selective timber management occupy only about 10 percent of the total area. Beginning at age 36, and continuously thereafter, the total costs per acre for 8 years of management, including annual costs of 19¢ and interest compounded at 3 percent, amount to $1.69. If doubled, these costs would be $3.38. The gross income per acre at the end of the first 8-year period, or when the stand is 44 years old, is estimated to be $10.60, including $7.80 from sawtimber stumpage (1,300 board feet at $6 per M) and $2.80 from pulpwood stumpage (2.8 cords at $1 per cord). The net income per acre for the 8-year period is $8.91, using present management costs, or an average of $1.11 per year. If these costs should double, the net income per acre would be $7.22 or 90¢ per year. The timber at this age is still relatively small, and the cut is more of an improvement cutting than a harvest cutting.

Beginning at age 52, however, when many of the trees have reached sizes desirable for sawtimber, and continuously thereafter, at 8-year intervals, it is estimated that a gross income of $21.60 per acre can be obtained; this includes $18.00 from sawtimber stumpage (3,000 board feet at $6 per M board feet) and $3.60 from pulpwood stumpage (3.6 cords at $1 per cord). This is equivalent to a gross income of $2.70 per acre per year. The net income per acre for each 8-year period with present costs of management would be $19.91, or $2.49 per year, and with doubled costs would be $18.22 or $2.28 per year. With a good growing stock always present on the ground, it is possible to take advantage of market conditions and to cut those products that have the greatest value, while this is not possible with even-aged pulpwood rotations. With present indications that future markets will recognize and pay accordingly for the better grades of stumpage, this selective method of cutting promises to become increasingly profitable.

Conclusions

Table 5 has been prepared to show more clearly the number of trees before and after each cut and their movement into larger diameter-classes during each 8-year period.

It should be noted that some natural reproduction is expected to become established following the thinning at 28 years after planting. More reproduction, of course, can be expected following later cuttings, when larger trees have been cut and larger openings made. Since sufficient trees are retained in the stand to guarantee the amount of production indicated through at least 80 years, the amount of natural reproduction that is necessary in any one 8-year period to perpetuate the stand is relatively small. If normal reproduction does become established, it is apparent that the yearly production of pulpwood may be greater than that indicated, since a considerable proportion of the naturally reproduced trees will be removed in later thinnings.

Table 5. Number of merchantable trees per acre by diameter-class and stand age

Diameter at breast height	Stand age 20		Stand age 28		Stand age 36		Stand age 44		Stand age 52	
	Before thinning	After thinning	Before thinning	After thinning	Before thinning	After thinning	Before thinning	After thinning	Before thinning	After thinning
Inches	Number of trees									
4	122	115	30	30	8	8	20	18	20	19
6	239	168	96	45	25	20	14	11	15	15
8	81	40	102	50	41	26	20	18	13	10
10	11	5	44	33	43	32	26	25	19	18
12			9	4	26	25	26	22	24	22
14			1		7	6	17	13	20	13
16					1	1	6	4	12	8
18							1	1	4	2
20									1	1
Total merchantable trees	453	328	282	162	151	118	130	112	128	108
Total cords in trees 4 inches to 12 inches d.b.h. inclusive	17.5	10.9	23.8	13.6	21.5	17.4	16.9	15.0	15.7	13.0
Total cords cut each cycle[1/]		6.6		10.5		4.5		2.8		3.6
Total volume in board feet in trees 14 inches d.b.h. and larger			178		1,689	1,473	6,317	4,739	11,244	7,639
Total board-foot volume cut each cycle								1,300		3,000

1/ From tops of sawlog-size trees as well as from entire trees.

From the above computations, evidently it should prove reasonably profitable for any Southern pulp company or land owner that can obtain productive forest land at a relatively low cost, to initiate a planting program, or, where naturally regenerated lands are available, to acquire well-stocked young stands for the commercial production of timber. For the pulp company, such an undertaking would insure future wood supplies for a period long enough to depreciate the plant investment economically. By planting areas within easy trucking distance of the pulpmill, companies could save freight charges of 75¢ to $2 per cord, and these savings might well be credited to stumpage values. With sawtimber stumpage worth two to four times the value of pulpwood stumpage, it evidently will pay the timberland owner to sell as much of his stumpage for sawtimber as he can, but also to take full advantage of available pulp markets in order to dispose of poor-quality material removed in stand improvement and from tops of sawtimber trees. A planting or acquisition program of 5,000 to 10,000 acres a year over a period of 10 to 15 years would not represent a very large investment and under skillful management should yield liberal returns.